UV-Based Treatment Processes for Emerging Microbial and Chemical Contaminants

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UV is now recognized to be an inexpensive and relatively easy means to achieve disinfection of *Cryptosporidium parvum* and does not appear to produce disinfection by-products at practical doses. Now, the germicidal effects of UV against emerging pathogens and challenges related to application of UV disinfection for filtered and unfiltered surface waters need to be assessed. These include: the susceptibility, repair potential, and resistance of select emerging pathogens and indicators to UV disinfection and understanding of the relative germicidal effectiveness of different wavelengths of UV. The extent to which microbes are associated with water treatment particles typical in unfiltered systems and the effects of this particle association and other water quality parameters on UV disinfection potential are also being investigated. Because the UV treatment process is an acceptable disinfectant, its effectiveness against other pollutants is also of great interest. A group of chemical contaminants known as endocrine disrupting chemicals (EDCs) can cause adverse effects on human and wildlife endocrine systems. EDCs of anthropogenic origin (xeno-estrogens) that are of concern in water and wastewater include pesticide residues (e.g., DDT, endosulfan, atrazine), alkylphenols (e.g., nonlyphenol), plastic additives (e.g., bisphenol A, diethyl phthalate), and pharmaceutical hormones (e.g., ethynyl estradiol) among others. There is a recognized need to develop appropriate water treatment processes that can effectively degrade these contaminants and render them non-toxic.

Numerous organisms on the US EPA Contaminant Candidate List (CCL) including bacteria (*Mycobacterium spp.*), viruses (adenoviruses, coxsackieviruses), and protozoans (*Toxoplasma gondii*) in addition to various indicator organisms are being evaluated for UV dose response, the relative wavelength effectiveness of UV irradiation, the potential for repair and reactivation under light and dark conditions, and the response to sequential application of UV and chlorine/chloramines. For the endocrine disrupting contaminants, the research is assessing, through use of bioassays and chemical analyses, the degradation, by-product formation and subsequent toxicity of endocrine disrupting compounds (bisphenol-A, nonylphenol, and ethynyl estradiol) following UV and UV oxidation treatment processes.

These research efforts partner water treatment process engineers with microbiologists and toxicologists to develop comprehensive and fundamental understanding of the effectiveness of UV processes for treating the pollutants of interest. The results of this research are expected to provide a thorough understanding of UV disinfection as applied to filtered and unfiltered surface water supplies as well as indicate the potantial for UV processes to treat emerging chemical contaminants. Utilities, regulators, and engineers will have more information on UV based processes to help guide the decisions they will need to make concerning treatment of pathogens and endocrine disrupting contaminants in the coming years, leading toward greater protection of public health.

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